

Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (cancelled)

Claim 2 (previously presented): In an optical communication system, apparatus for amplifying an optical signal, said apparatus comprising:

a fiber; and

an optical pump energy source disposed to inject optical pump energy into said fiber in a co-propagating direction relative to a transmission direction of an optical signal in said fiber to cause Raman amplification of said signal in accordance with a gain level; and

wherein said gain level is greater than 4 dB; and

wherein either 1) for a selected signal to noise ratio, there is a greater four-wave mixing product suppression level than would be achieved using only a counter-propagating optical pump energy source to obtain said gain level or 2) for a selected four-wave mixing product suppression level, there is a higher signal to noise ratio than would be achieved using only said counter-propagating energy source to obtain said gain level; and

wherein said gain level is set responsive to a minimum tolerable four-wave mixing product suppression level and a desired signal to noise ratio.

Claim 3 (cancelled)

Claim 4 (previously presented): In an optical communication system, apparatus for amplifying an optical signal, said apparatus comprising:

a first optical pump energy source disposed to inject optical pump energy into a fiber in a co-propagating direction relative to a transmission direction of said optical signal to cause Raman amplification of said signal in accordance with a first gain level;

a second optical pump energy source disposed to inject optical pump energy into said fiber in a counter-propagating direction relative to said transmission direction of said optical signal to cause Raman amplification of said signal in accordance with a second gain level, said optical signal experiencing a total gain level including said first gain level and said second gain level; and

wherein said first gain level is greater than 4 dB wherein either 1) for a selected signal to noise ratio, there is a greater four-wave mixing product suppression level than would be achieved using only said second optical pump energy source to obtain said total gain level or 2) for a selected four-wave mixing product suppression level, there is a higher signal to noise ratio than would be achieved using only said second optical pump energy source to obtain said total gain level; and

wherein said first gain level is set responsive to a minimum tolerable four-wave mixing product suppression level and a desired signal to noise ratio.

Claim 5 (cancelled)

Claim 6 (previously presented): The apparatus of claim 4 wherein said first gain level is also set responsive to a maximum tolerable saturation level.

Claim 7 (previously presented): The apparatus of claim 4 wherein said second gain level is set responsive to said first gain level and said total gain level.

Claim 8 (cancelled).

Claim 9 (previously presented): The apparatus of claim 4 wherein a power level of said first optical pump energy source is set responsive to said first gain level.

Claim 10 (previously presented): The apparatus of claim 4 wherein a power level of said second optical pump energy source is set responsive to said second gain level.

Claim 11 (previously presented): The apparatus of claim 4 further comprising said fiber.

Claim 12 (previously presented): The apparatus of claim 4 further comprising:

an Erbium-doped fiber amplifier in cascade with said fiber.

Claims 13-18 (cancelled).

Claim 19 (previously presented): In an optical communication system, a method for amplifying an optical signal within a fiber by exploiting Raman effects to achieve a desired gain level, said method comprising:

injecting co-propagating optical pump energy into said fiber to cause Raman amplification according to a first gain level;

injecting counter-propagating optical pump energy into said fiber to cause Raman amplification according to a second gain level; and

wherein said first gain level is greater than 4 dB;
wherein either 1) for a selected signal to noise ratio at an output of said fiber, there is a greater four-wave mixing product suppression level than would be achieved injecting only said counter-propagating optical pump energy to obtain said desired gain level or 2) for a selected four-wave mixing product level, there is a higher signal to noise ratio than would be achieved using injecting only said counter-propagating optical energy to obtain said desired gain level; and

wherein injecting co-propagating optical pump energy comprises injecting co-propagating optical energy at a power level set responsive to a minimum tolerable four-wave mixing product suppression level and a desired signal to noise ratio.

Claim 20 (cancelled)

Claim 21 (previously presented): The method of claim 19 wherein said power level is also set responsive to a maximum tolerable saturation level.

Claim 22 (previously presented): The method of claim 19 further comprising:
further amplifying said signal within an Erbium-doped fiber amplifier.

Claim 23 (cancelled)

Claim 24 (previously presented): In an optical communication system, apparatus for amplifying an optical signal within a fiber by exploiting Raman effects to achieve a desired gain level, said apparatus comprising:

means for injecting co-propagating optical pump energy into said fiber to cause Raman amplification;

means for injecting counter-propagating optical pump energy into said fiber to cause Raman amplification according to a second gain level; and

wherein said first gain level is greater than 4 dB; and
wherein either 1) for a selected signal to noise ratio at an output of said fiber, there is a greater four-wave mixing product suppression level than would be achieved injecting only said counter-propagating optical pump energy to obtain said desired gain level or 2) for a selected four-wave mixing product level, there is a higher signal to noise ratio than would be achieved injecting only counter-propagating optical energy to obtain said desired gain level; and

wherein said means for injecting co-propagating optical pump energy comprises means for injecting co-propagating optical energy at a power level set responsive to a minimum tolerable four-wave mixing product suppression level and a desired signal to noise ratio.

Claim 25 (cancelled)

Claim 26 (previously presented): The apparatus of claim 24 wherein said power level is also set responsive to a maximum tolerable saturation level.

Claim 27 (previously presented): The apparatus of claim 24 further comprising:
means for further amplifying said signal within an Erbium-doped fiber amplifier.